<u>Assignment-1</u>

Due date: 10^{th} Aug 2024

Noiseless Channel

1. A channel has a bandwidth of 4 kHz. What is the maximum data rate if the signal being used is binary (2 levels)?
2. If the same channel (bandwidth of 4 kHz) uses 8-level signals, what is the maximum data rate?
3. A channel has a bandwidth of 4 kHz and uses binary signals (2 levels). Calculate the maximum data rate and the number of bits per signal level.
4. Given a channel with a bandwidth of 4 kHz and a maximum data rate of 24 kbps, determine the number of signal levels used.
5. A channel with a bandwidth of 5 kHz achieves a maximum data rate of 40 kbps. What is the number of signal levels used? Verify the results by calculating the bits per signal level.
6. For a channel with a bandwidth of 2.5 kHz, if the maximum data rate is 20 kbps, find the number of signal levels and the corresponding bits per signal level.
7. A channel has a bandwidth of 10 kHz and uses binary signals (2 levels). What would the required bandwidth be if the maximum data rate needs to be doubled?
8. If a channel with a bandwidth of 6 kHz achieves a maximum data rate of 36 kbps, determine the number of signal levels and calculate the bandwidth required if the data rate is increased to 72 kbps.
9. Calculate the maximum data rate for a channel with a bandwidth of 8 kHz using 256-level signals. Then, find the required bandwidth if the number of signal levels is reduced to 64 and the maximum data rate is maintained.
10. A channel with a bandwidth of 12 kHz uses signals with 128 levels. If the bandwidth is reduced to 6 kHz, determine the new number of signal levels required to maintain the same maximum data rate.
11. Given a channel with a bandwidth of 1.5 kHz and using 4-level signals, find the maximum data rate. If the bandwidth is increased to 3 kHz, calculate the new maximum data rate and the bits per signal level.
12. For a channel with a bandwidth of 20 kHz, using 1024-level signals, calculate the maximum data rate. Then, determine the required bandwidth if the data rate is halved while maintaining the same number of signal levels.

Noisy Channel

1. A channel has a bandwidth of 5 kHz and a signal-to-noise ratio (SNR) of 20 dB. Calculate the channel capacity.
2. If a channel with a bandwidth of 10 kHz has a channel capacity of 40 kbps, determine the SNR in dB.
3. A channel with a bandwidth of 15 kHz has an SNR of 30 dB. What is the maximum data rate that can be achieved on this channel?
4. For a channel with a bandwidth of 8 kHz and an SNR of 25 dB, calculate the channel capacity. If the SNR is halved, what will be the new channel capacity?
5. A channel has a channel capacity of 50 kbps and an SNR of 10 dB. Determine the bandwidth of the channel.

6. Given a channel with a bandwidth of 12 kHz and a channel capacity of 60 kbps, find the required SNR in linear scale.
7. Calculate the channel capacity for a channel with a bandwidth of 20 kHz and an SNR of 15 dB. If the bandwidth is doubled and the SNR remains the same, what is the new channel capacity?
8. A channel with a bandwidth of 25 kHz has an SNR of 35 dB. If the channel capacity is to be increased by 50%, determine the new SNR required, assuming the bandwidth remains constant.
9. Given a channel with a bandwidth of 30 kHz and an SNR of 40 dB, calculate the channel capacity. What bandwidth would be required to achieve the same channel capacity if the SNR is reduced to 20 dB?
10. For a channel with a bandwidth of 18 kHz and an SNR of 22 dB, calculate the channel capacity. If the channel capacity needs to be doubled, determine the new required bandwidth, assuming the SNR remains constant.

Line Encoding

1. Construct the waveform for the binary sequence 110101 using: Unipolar Non-Return-to-Zero (NRZ), Unipolar Return-to-Zero (RZ), Manchester encoding
2. Construct the waveform for the binary sequence 1001101 using: Differential Manchester encoding, Alternate Mark Inversion (AMI), Bipolar Return to Zero
3. Construct the waveform for the binary sequence 01101001 using: Polar NRZ-I encoding, Manchester and Differential Manchester
4. Construct the waveform for the binary sequence 10101110 using: Non-Return-to-Zero (NRZ), Manchester encoding
5. Construct the waveform for the binary sequence 110011 using: Return-to-Zero (RZ), Differential Manchester encoding
6. Construct the waveform for the binary sequence 100111 using: Non-Return-to-Zero (NRZ), Polar NRZ-I encoding
7. Construct the waveform for the binary sequence 111000 using: Manchester encoding, Differential Manchester Encoding, RZ,NRZ-L,NRZ-I
8. Construct the waveform for the binary sequence 011010 using: Unipolar Non-Return-to-Zero (NRZ), Bipolar Return-to-Zero(RZ),
9. Construct the waveform for the binary sequence 101010 using: Non-Return-to-Zero (NRZ), Differential Manchester encoding,Manchester encoding